

CELL GROWTH AND DIVISION

Chapter 10

- **Cell division** =

- The formation of 2 daughter cells from a single parent cell
- Increases ratio of surface area to volume for each cell
- Allows for more efficient exchange of materials within cell

- **Asexual reproduction** =
 - Genetically identical offspring produced from a single parent
 - Increases population quickly
 - Ex: Bacteria, some plants and simple animals (hydra)
- **Sexual reproduction** =
 - Cells from 2 parents unite to form first cell of new organism
 - Increases genetic diversity
 - Ex: Most plants and animals

Cell Division in Prokaryotes

- Lack nuclei and many organelles
- DNA is found directly in cytoplasm
- Contain a single, circular DNA chromosome
- **Binary fission** =
 - Asexual reproduction in which DNA is replicated and cell divides in half
 - Produces 2 identical daughter cells

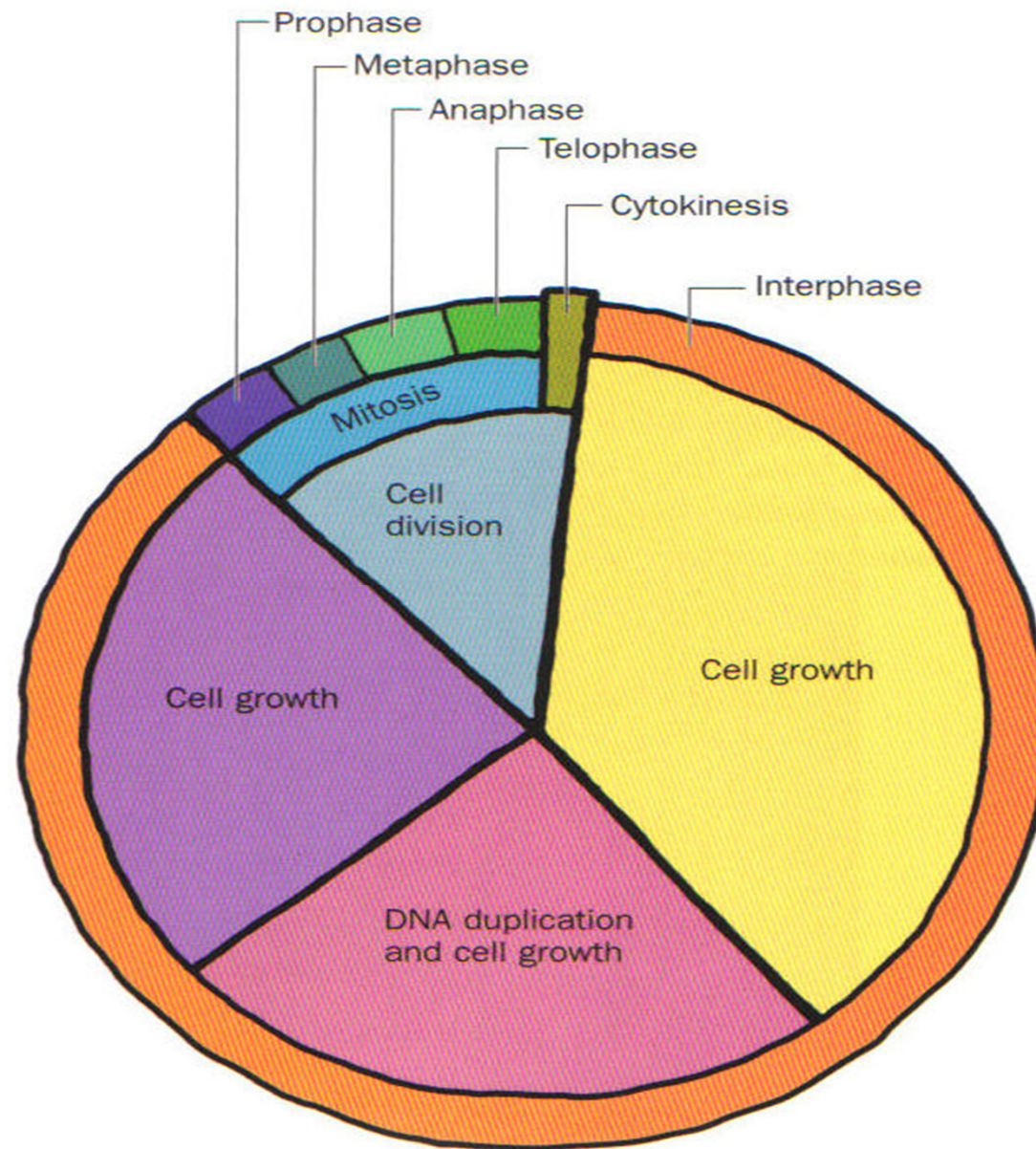
Cell Division in Eukaryotes

- **Mitosis** =
 - Forms new body cells for growth and tissue repair
- **Meiosis** =
 - Forms sex cells for reproduction
- **Apoptosis** =
 - Programmed cell death
- Coordination of cell division and apoptosis maintains cell numbers

- Somatic cells (body cells)
 - **Diploid** = contains 2 sets of chromosomes
 - Human somatic cells have 46 chromosomes (23 pairs)
 - 1 pair are sex chromosomes
 - XX = female
 - XY = male
 - Remaining 22 pairs are called **autosomes**
 - Formed by mitosis
- Reproductive cells (sperm and egg)
 - **Haploid** = contains 1 set of chromosomes
 - Union of sperm and egg restores the diploid state
 - Formed by meiosis

Cell Cycle

- **Interphase** (between cell divisions)
 - Gap phases (G_1 and G_2)
 - Cell grows
 - Proteins and lipids are produced
 - Synthesis phase (S)
 - Chromosomes are copied
- Cell division
 - **Mitosis** = division of nucleus
 - 2 identical daughter cells produced
 - Broken down into 4 phases
 - **Cytokinesis** = division of cytoplasm

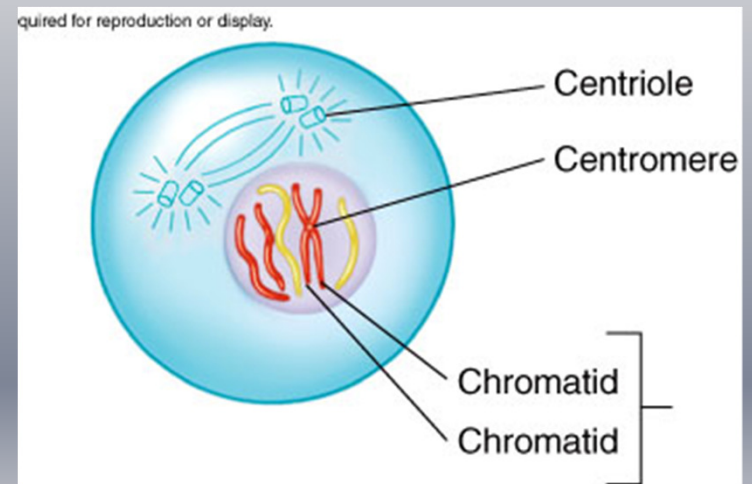


Mitosis



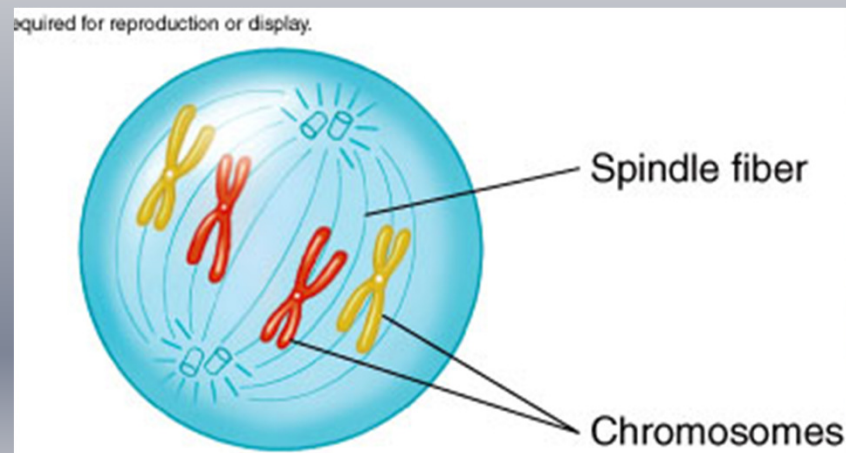
1. Prophase

- First and longest phase of mitosis
- DNA coils tightly and chromosomes become visible
 - Each chromosome is composed of 2 identical strands called *sister chromatids* =
 - Identical copies of the same chromosome
 - Paired sister chromatids are attached along *centromere*
- Centrioles appear and spindle assembles
- Nuclear envelope breaks down



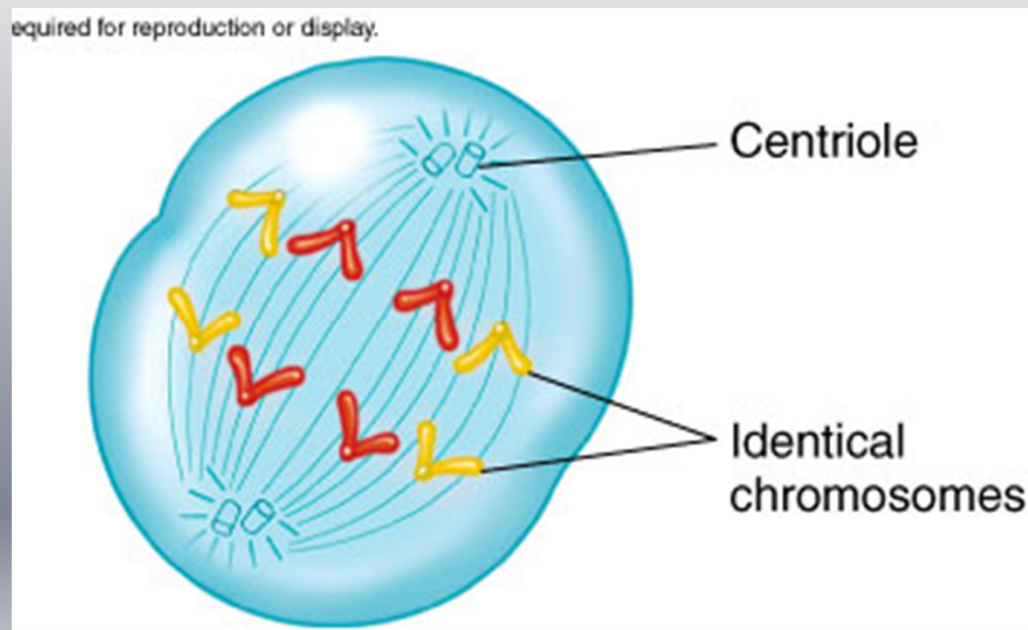
2. Metaphase

- Second phase of mitosis
- Shortest phase
- Chromosomes line up across Middle of cell



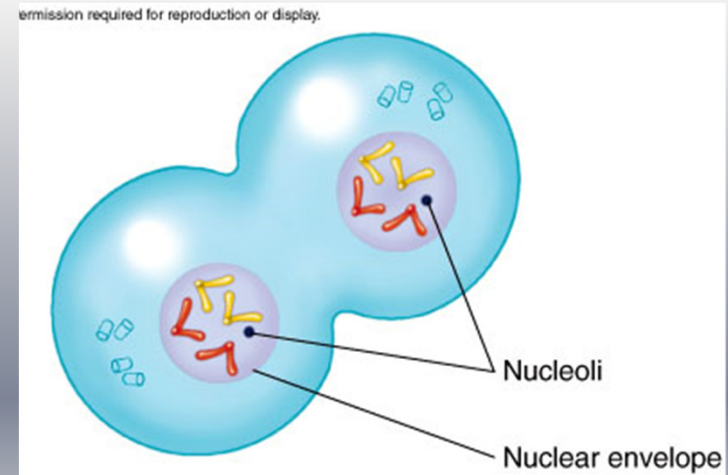
3. Anaphase

- Third phase in mitosis
- Chromatids separate and move Apart toward the centrioles at each end of the cell



4. Telophase

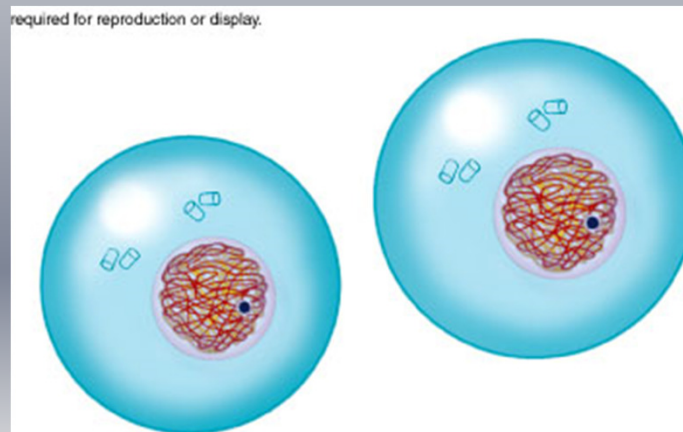
- Fourth phase of mitosis
- Chromosomes disperse
(half on each side of cell)
- Spindle disassembles
- Two nuclear envelope reform
(one at each end)



Cytokinesis

Mitosis is followed by **cytokinesis** =

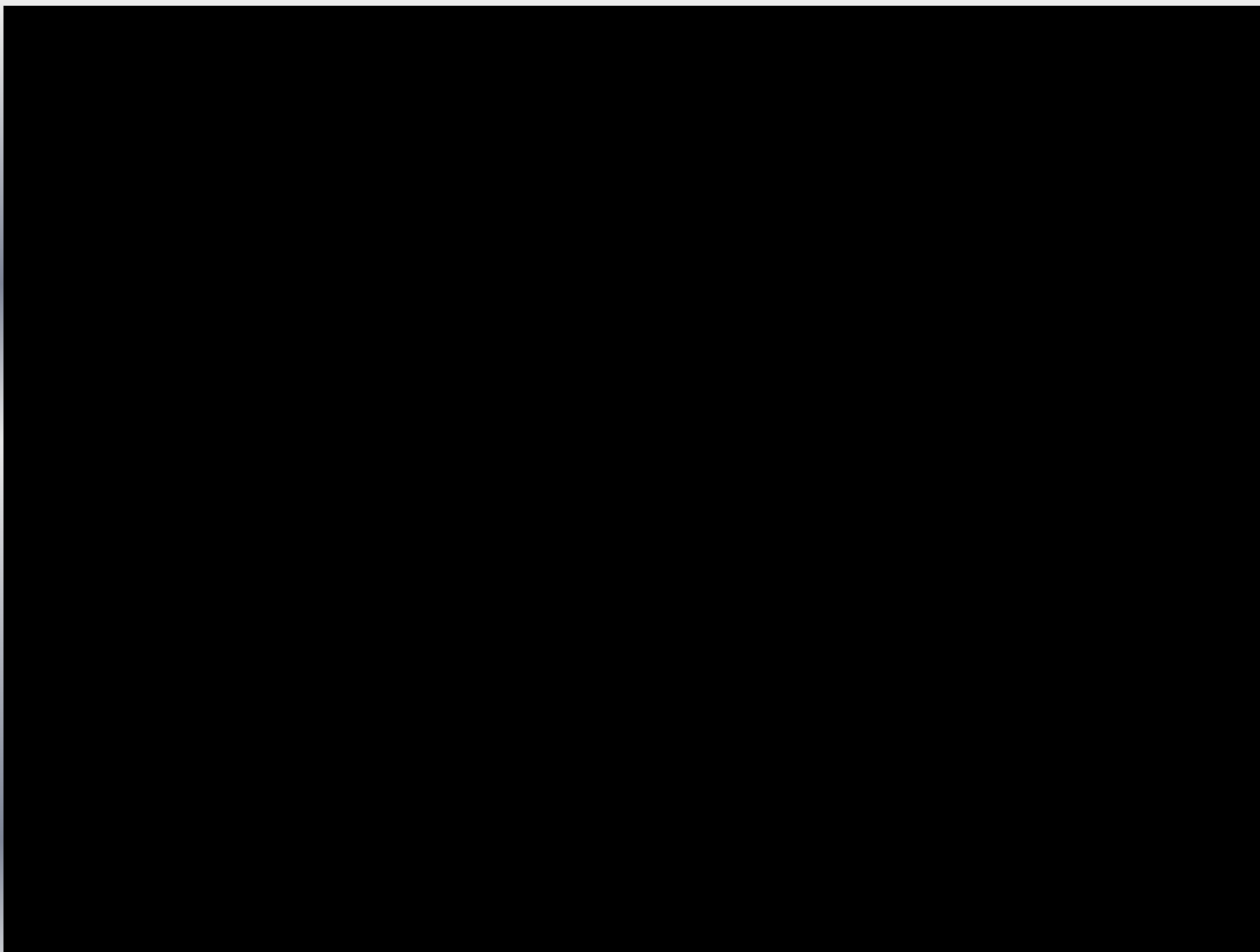
- Division of the cytoplasm and its components
- Animal cells
 - Cell membrane pinches inward
- Plant cells
 - Cell plate forms between 2 nuclei



Meiosis

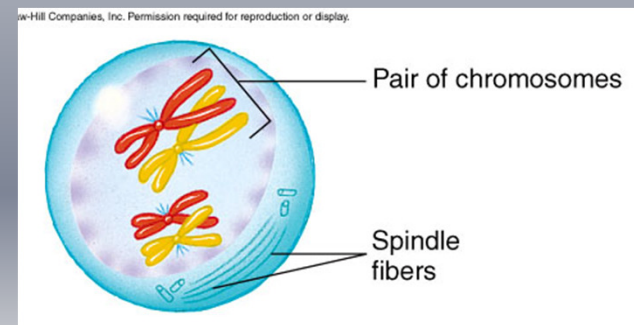
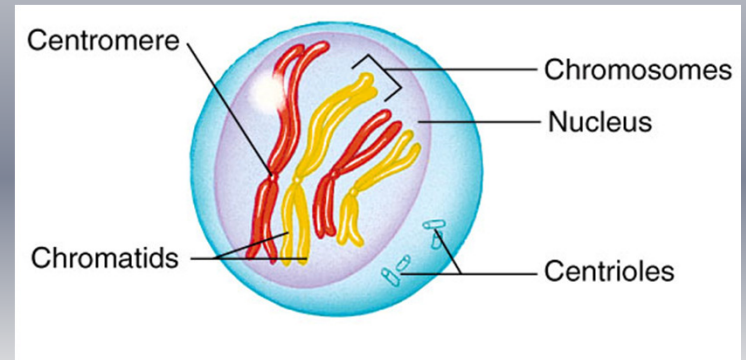
- **Meiosis** =
 - Cell division that halves the number of chromosomes to form haploid gametes
 - Mixes up trait combinations, providing genetic diversity
- Chromosomes pairs are called **homologs**
 - One comes from mom and one comes from dad
 - Have same genes in same order
 - May carry different alleles (variants) of the same gene

- Interphase
 - DNA is replicated
- 2 divisions of genetic material
 - Meiosis I
 - Reduces number of replicated chromosomes from 46 to 23
 - Meiosis II
 - Produces 4 total cells by splitting the replicated chromosomes



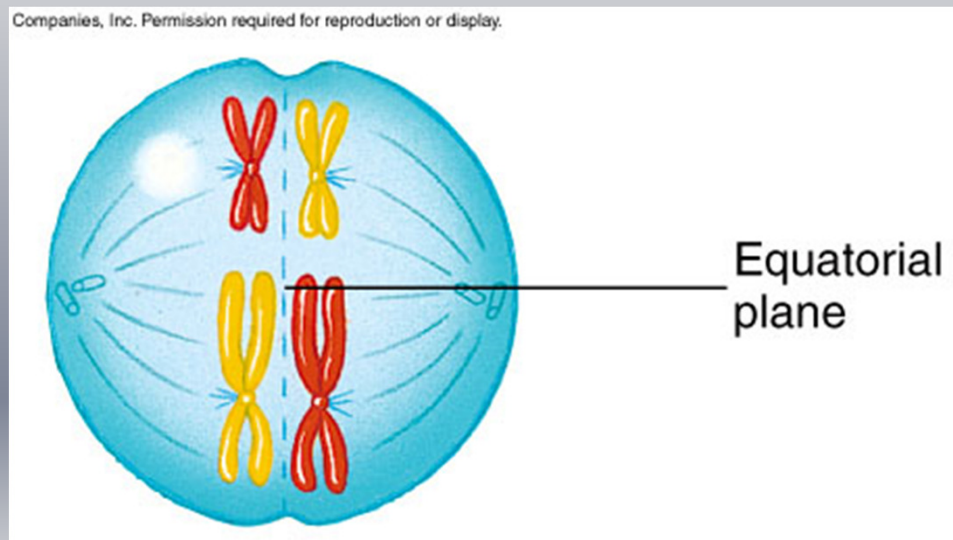
Prophase I

- Replicated chromosomes condense and become visible
- Spindle forms
- Nuclear envelope fragments
- **Synapsis** =
 - Homologs **P**air up to form a **tetrad** =
 - 4 chromatids
- **Crossing over** =
 - Homologs exchange parts
 - Increases genetic diversity!



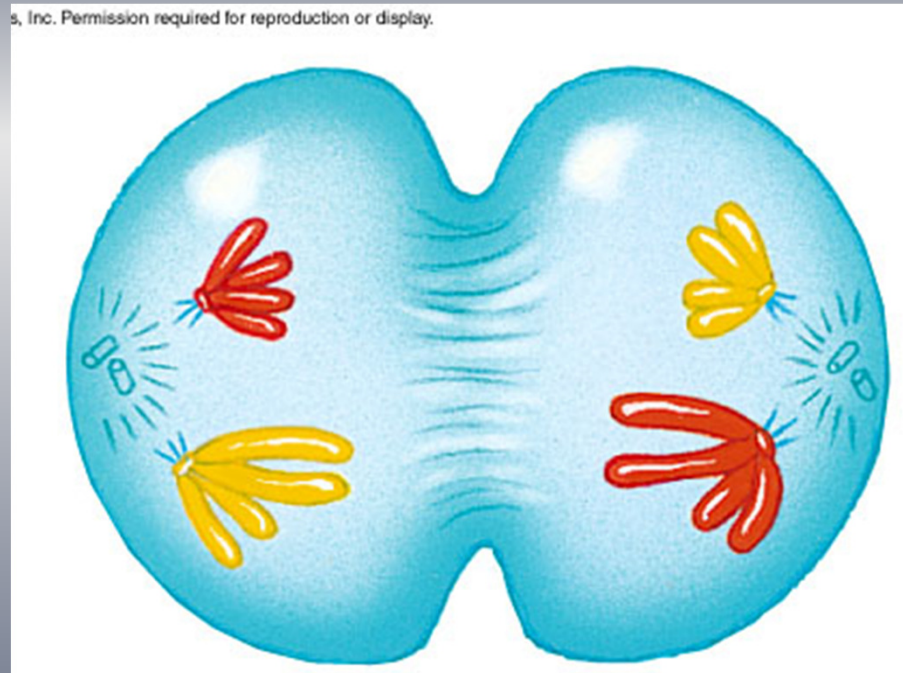
Metaphase I

- Paired homologs line up across Middle of cell
- **Independent assortment** =
 - Random alignment of homologs



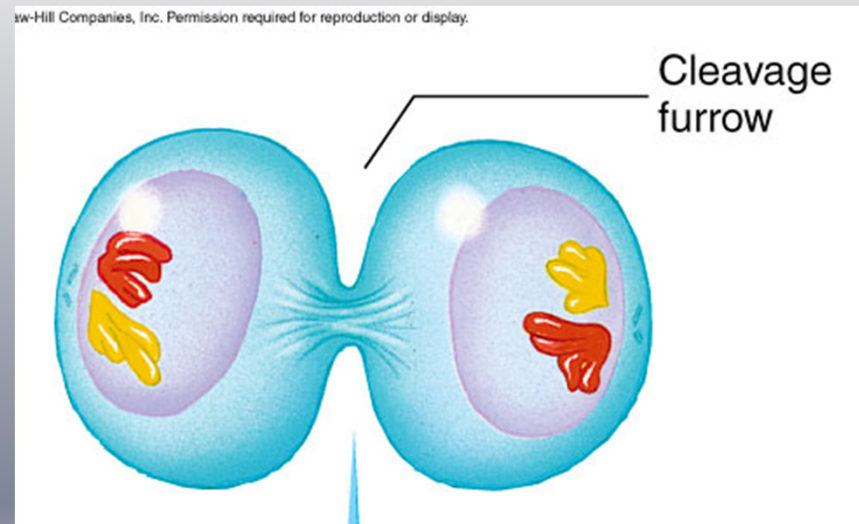
Anaphase I

- Homologs move Apart to opposite poles of cell



Telophase I

- Two nuclear envelopes partially assemble around chromosomes on either side of cell
- Spindle disappears
- Cytokinesis divides cell into two

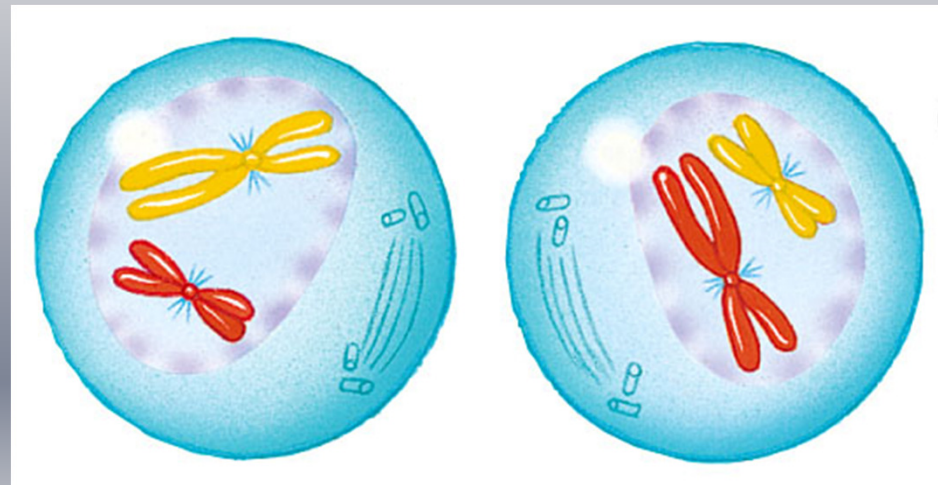


Results of Meiosis I

- 2 cells
- Haploid with replicated chromatids
- Second Interphase
 - Proteins are manufactured
 - NO DNA replication

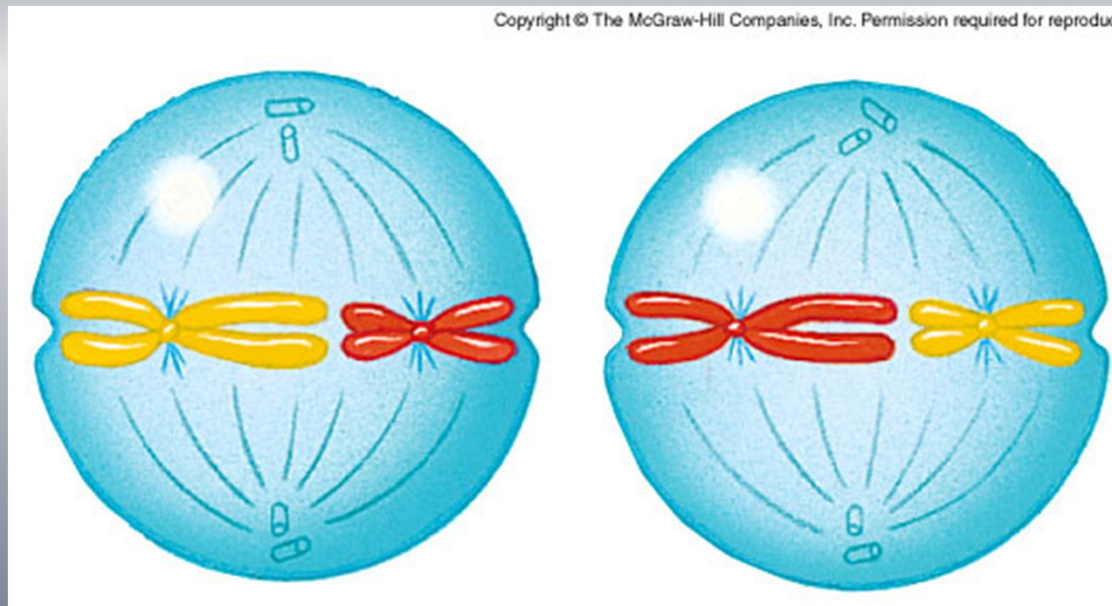
Prophase II

- Chromosomes are again condensed and visible
- Nuclear envelope fragments
- Spindle forms and fibers attach to both chromosomes



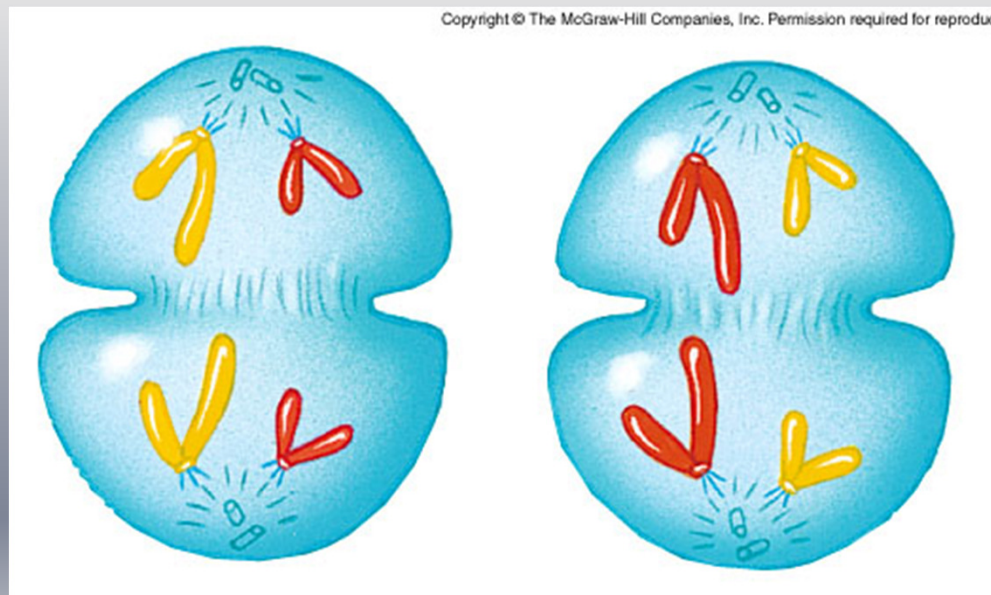
Metaphase II

- Replicated chromosomes line up across middle of cell



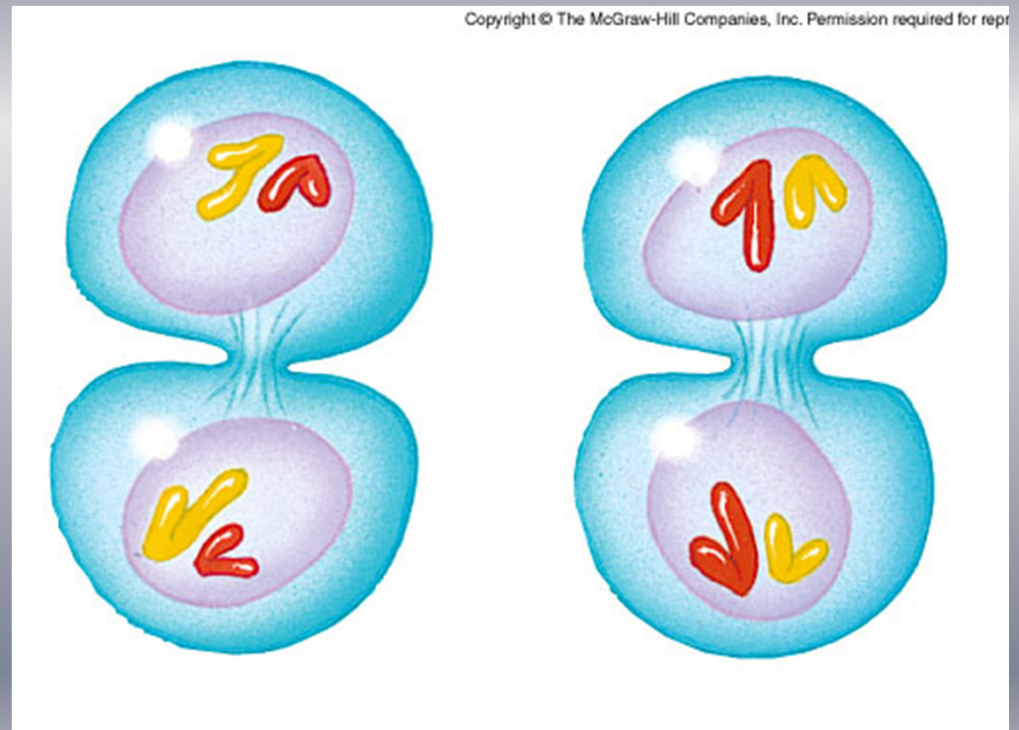
Anaphase II

- Sister chromatids separate and move apart to opposite poles



Telophase II

- Nuclear envelopes form around 4 nuclei
- Spindle disappears
- Cytokinesis divides cells into 4
- Result:
 - 4 cells
 - Nonidentical
 - Haploid



Mitosis

- One division
- 2 daughter cells
- Daughter cells genetically identical
- Chromosome # of daughter cells same as that of parent cell (diploid)
- Occurs in body cells
- Used for growth, repair, and asexual reproduction

Meiosis

- Two divisions
- 4 daughter cells
- Daughter cells genetically different
- Chromosome # of daughter cells half that of parent cell (haploid)
- Occurs in reproductive cells
- Used for sexual reproduction, producing new gene combinations

